

# Claims

- [c1] 1. An optical element (transmissive or reflective) comprising,
- (a) a substrate;
  - (b) a first diffraction grating layer;
  - (c) a single uniform layer, and;
  - (d) a second diffraction grating layer.
- [c2] 2. An optical element (transmissive or reflective) comprising,
- (a) the said substrate as claimed in Claim 1, and;
  - (b) A single or multiple sequences of layers, wherein each sequence comprising;
    - (i) the said first diffraction grating layer as claimed in claim 1;
    - (ii) the said single uniform layer as claimed in Claim 1, and
    - (iii) the said second diffraction grating layer as claimed in claim 1.
- [c3] 3. An optical element (transmissive or reflective) comprising,
- (a) the said substrate as claim in Claim 1;
  - (b) the said single uniform layer as claimed in claim 1,

and;

(c) the said first diffraction grating layer as claimed in claim 1.

[c4] 4. An optical element (transmissive or reflective) comprising,

(a) the said substrate as claimed in claim 1, and;

(b) A single or multiple sequences of layers, wherein each sequence comprising;

(i) the said single uniform layer as claimed in claim 1, and;

(ii) the said first diffraction grating layer as claimed in claim 1.

[c5] 5. An optical element (transmissive or reflective) comprising,

(a) the said substrate as claimed in claim 1;

(b) the said first diffraction grating layer as claimed in Claim 1, and;

(c) the said single uniform layer as claimed in Claim 1.

[c6] 6. An optical element (transmissive or reflective) comprising,

(a) the said substrate as claimed in claim 1, and;

(b) A single or multiple sequences of layers, wherein each sequence comprising;

(i) the said first diffraction grating layer as claimed in

Claim 1, and ;

(ii) the said uniform layer as claimed in Claim 1.

- [c7] 7. The said first diffraction grating as claimed in the Claim 1 have the grating patterns with 2 or more steps per period and they are synchronously or non-synchronously sampled diffraction gratings.
- [c8] 8. The steps of grating patterns as claimed in claim 7 are having the phase depths, which are in a binary or non-binary sequences.
- [c9] 9. The said first diffraction grating as claimed in the Claim 1 are the type of angle dependent or independent to the incident beam.
- [c10] 10. The material type for the said substrate as claimed in claims 1, is barillium fluoride (BaF), or diamond, or zinc sulphide (ZnS) or zinc selenide (ZnSe) or zinc oxide (ZnO) for the near to long infrared wavelengths of lights.
- [c11] 11. The material type for the said substrate as claimed in claims 1 is doped or nondoped type glass or semiconductor (e.g. GaAs or InP or Si) having transmissive characteristic over particular spectral region.
- [c12] 12. Materials having the refractive indices in between 1.6 and above for the said uniform layer as claimed in claim

1, in between 1.0 and 3.0 for the low refractive index material in the said first or second diffraction gratings as claimed in Claim 1, in between 1.5 to 3.5 for the high index material in the said first or second diffraction gratings as claimed in Claim 1, and in between 1.42 to 2.5 for the said substrate as claimed in Claim 1, can be used for the optical elements as claimed in claims 1.

[c13] 13. The materials for the said first or second diffraction gratings, as claimed in claims 1, are yttrium oxide as the low index material and diamond as the high index material, and the material for the uniform layer, as claimed in claims 1 is zinc sulphide.

[c14] 14. The materials for the said first or second gratings, as claimed in claim 1 are two material combination for the low-index and high index materials which are from  $\text{ZrO}_2$ ,  $\text{HfO}_2$ ,  $\text{Si}_3\text{O}_4$ , or  $\text{Y}_2\text{O}_3$ .

[c15] 15. The materials for the said uniform layer, as claimed in claim 1 are  $\text{TiO}_2$ ,  $\text{SiO}_2$ ,  $\text{Si}_3\text{O}_4$ ,  $\text{ZrO}_2$ ,  $\text{ZnS}$ ,  $\text{ZnSe}$ ,  $\text{ZnO}$ ,  $\text{HfO}_2$ ,  $\text{Si}_3\text{O}_4$ , or  $\text{Y}_2\text{O}_3$ .

[c16] 16. The thickness of the first or second diffraction grating layer and also the said uniform layer, as claimed in Claim 1 is either quarter-wavelength or  $n$  times quarter-wavelength, wherein  $n$  is the integer where  $n=1,2,3,4$

and so on.

[c17] 17. The said first or second diffraction grating layers as claimed in Claim 1, separated by the said uniform layer as claimed in claim 1, is formed in a way that either low(high) refractive indices are in the same position or in the different position.

[c18] 18. The optical elements (for both reflective and transmissive type) as claimed in claim in 1 can also have the antireflection coating from where the light is incident.

[c19] 19. The fabrication process of the optical elements as claimed in claim 1, having single or multiple sequences of processes, wherein each sequence process comprises, (a) formation of gratings on the top of the substrate using the processes that comprises, (i) the low or high index material deposition using the vacuum deposition technique; (ii) photolithography-based patterning; (iii) dry etching; (iv) deposition of the high or low index material using the vacuum deposition technique; and (v) planarization; (b) deposition of the uniform layer on the top of the grating as mentioned in the claim 19(a), and; (c) formation of the grating as claimed in claim 19(a).

[c20] 20. The diffraction grating formation mentioned in the

claim 19 includes the process of laser drilling or process of gray-scale photolithography mask.